SCIENCE

FRIDAY, MARCH 9, 1888.

THE ADDRESS OF Maj. J. W. Powell on evolution in civilized man, delivered before the Anthropological Society of Washington on Tuesday evening, a full abstract of which is given in our Washington letter, will be found interesting and important. It will be seen that Major Powell rejects the doctrines of evolution as applied to the development of civilized man by the Spencerian school of philosophers. He presents his argument in his usual lucid and forcible manner, and illustrates each point copiously. This address is more popular in its character than either of Major Powell's previous papers on the same subject, but as a scientific discussion of an important scientific question, it is, in our estimation, the best of the series.

THE LATEST REPORTS received by the Hydrographic Office about the logs of the great raft abandoned south of Nantucket about two and one-half months ago, prove, that, though they are now widely separated, their general drift has been in an east-south-east direction, the logs being found a little to the southward of this line. That they were not carried more to the northward and eastward by the Gulf Stream, as would be expected, was probably due to the strong north-west winds which prevailed during the latter part of December and the first part of January. Fortunately, no vessel has been disabled by collision with them, although the German bark 'Bremen,' which was in company with the logs for five days, in latitude 39° north, longitude 62° west, had her sheathing torn and rudder injured.

THE NEW YORK ACADEMY OF SCIENCES was organized in 1817 as the Lyceum of Natural History. It is fourth in point of age among American scientific societies. The name and constitution were changed in 1876. 'The Annals,' begun in 1824, have been distributed in all lands, and have given world-wide reputation to the society. The Transactions, begun in 1881, give a record of the meetings, papers, and discussions, are published in monthly or bi-monthly numbers, and make an octavo volume each year. The library now numbers over eight thousand titles, and is especially rich in sets of the publications of foreign societies. It is now on deposit in the Library Building of Columbia College, and is accessible to the public from 8 A.M. to 10 P.M. every day of the year except Sundays. The cabinet was destroyed by fire in 1866. Previous to that date it was the principal collection in the city, and did a noble work. The academy has long looked forward to the time when it could secure a building of its own, such as the corresponding societies in Boston and Philadelphia have long enjoyed. It is not to the credit of New York that its oldest scientific organization, after nearly three-quarters of a century of steady and persevering activity, should be still unprovided with a building, while many other cities can show noble monuments of scientific interest and public spirit. Why should not the recent meeting of the American Association in this city be permanently commemorated by the erection of a fire-proof building for the accommodation of the academy, or perhaps of several other societies under the same roof, — a building which should be at once a benefit and an honor to the metropolis of America? The interest of the community has been aroused and quickened in the direction of science by the meeting of the association, and the Academy of Sciences would now invite the citizens of New York to take a greater interest in its work.

THE NATIONAL ELECTRIC LIGHT CONVENTION.

THE National Electric Light Association met in Pittsburgh on Feb. 21, and continued in session for three days. The association is mainly made up of representatives of the various arc lighting companies and of the alternating system of incandescent lighting. As Pittsburgh is the headquarters of the Westinghouse Company, and as the Westinghouse Company practically represents just at present the alternating system of electrical distribution, the investigation and discussion of the system occupied a considerable part of the time of the convention, although a couple of papers were read on underground electrical conductors, and other subjects were discussed which will be mentioned below.

The most important paper was by Mr. T. C. Smith, the title being 'The Distribution of Electricity by Alternating Currents.' The alternating system, briefly, consists in distributing the alternating currents at high potential, reducing to the low potential necessary for safety and for the running of incandescent lamps, by means of 'transformers,' — that is, induction-coils working backward, — changing high-potential to low-potential currents. Mr. Smith's paper gave the practical experience he had gained in working with the system, and very frankly told some of the difficulties he had met. With regard to the best way of running the circuits, he says, "The general question as to whether it is better to use separate circuits for separate machines, or to couple them into a general set of 'bus' wires and distribute from them, is too large to be lightly decided; as also is the question as to whether it is best to run separate circuits for separate districts, or to run into a general system of high-pressure mains outside of the station, feeding into these mains at different points, and again distributing from them. . . . There seems to be no doubt that in underground systems the network of high-pressure mains would be best, but for over-head work we have adopted the system of separate circuits from separate dynamos. . . . I now come to the question of the placing of the converters; and for this I think that you may safely lay down the general rule, that, wherever you are simply carrying current, do it at a high potential, and keep your low pressure for purely local distribution. With proper precautions, I do not see that there is any real danger in carrying the high-pressure wires into and through the building. . . . We started in with the idea that it was better, in cases where we had from the number of lights in a building to use more than one converter, to bank them; that is to say, connect all the primaries and all the secondaries in parallel, . . . but two or three peculiar experiences have led us to change our plans, and never to do so if it can be easily avoided."

Following Mr. Smith's paper was one by Mr. Shallenberger, on 'The Energy of Alternating Currents.' The first part of this paper was a description of the ordinary and well-known phenomena of alternating currents: they have been sufficiently described in a former paper in this journal.[1] The following, however, is suggestive: "The question naturally arises, What effect does this new element of self-induction have on the possibilities of practical measurements of alternating currents for commercial work?" The two cases in which the effect is negligible are, 1st, the measurement of the current through an incandescent lamp; and, 2d, the current supplied to lamps through converters with cores far below saturation, and carrying a fair proportion of their full normal load. "There is a third case, however, which arises in practice, in which central station instruments give a somewhat false notion of the actual energy transformed to the circuits; and this is the one in which a large number of converters are connected to the primary circuit, but with the secondaries open." In this case we may have no energy transformed, "while at the same time a considerable reading might be shown on the current instruments."

Now, I have quoted from these papers principally because I wish

[1] Abstract of paper on alternating current motors, *Science*, Feb. 24, 1888.

to point out some disadvantages of the alternating system. The advantages of the system, as allowing the distribution of incandescent lights over extended areas, are so well known, that it is no more than fair that the drawbacks should be recognized, as it is by the honest investigation of every side of a case that science and industries advance. It was pointed out in the paper on motors referred to above, that the energy, being transformed, which is equal to CE, the product of the electro-motive force by the current, could be changed in two ways: supposing E is constant, we can either change the absolute value of C, or we change the position of its maximum with respect to the maximum of E. Now, if the former was what actually occurred, as we decreased the work being done, — turned out a number of lamps, for instance, — we would decrease the current; and the heating of the line wire, equal approximately to $\frac{C_0^2}{2} R$, would decrease in a still greater proportion. But this is not what really occurs. We have only a partial decrease of current, the total decrease being partly made up by a shift of the position of the curve representing C. It was pointed out that this was a disadvantage, as the heating of the line was independent of the *position* of the current curve, depending simply on its *value*. There is another disadvantage in this, which was not mentioned in the paper referred to. A dynamo cannot carry more than a certain current, corresponding to its maximum capacity. Now, if there were absolutely no change in the *value* of the current from full load to no load, it would mean that all of the dynamos in the station would have to be run all the time; for, if we distributed the current among a few of them, they would rapidly heat and burn out. It is evident that this state of affairs would be most uneconomical, since the absolute number of horse-power lost in each machine varies very little with the load, and, besides these losses, we have the depreciation and wear on the machinery. Of course, the engines, supposing there were no lamps being burned, would be doing very little work, running uneconomically. In practice we do not have this state of affairs: the current *does* decrease in value as lamps are turned out in the secondary circuits, but it *does not* decrease proportionally to the lamps turned out, and we must run more dynamos than are necessary to supply the energy required in the lamps; and this at a reduced load, and therefore at a low efficiency. There are a number of interesting points that might be brought out here, but until I have calculated the results of some experiments, and have from them some reliable data as to the magnitude of the different effects, I will not push the matter further.

From Mr. Smith's paper it would seem that the Westinghouse Company have found it best to run the converters separately; that is, not to join a number of them in parallel. Now, the objections to this are, 1st, that it does not allow the converting system to take advantage of the law of averages; and, 2d, that as each converter is only working for a limited time on full load, and as the efficiency on partial loads is not great, the total efficiency is much reduced. As for the first, it is well known that if the total number of lamps in a certain district is, say, 2,000, the maximum capacity of the station required to supply them by a direct system will be very much less, say, 1,000 lamps; this, of course, because all the houses in the district will never have all of their lamps burning at once. If, however, we wish to supply them by converters, using a converter in each house, the capacity of our converters would have to be 2,000 lamps, since any one house might have all the lamps burning on some special occasion. If we calculate the amount of gas we could burn in a month, supposing each jet were burning all the time, and compare with the amount we actually do burn, we will find that we use, perhaps, one-twentieth part of the maximum capacity of our lights. Now, a converter working at an average of one-twentieth of its capacity is not an especially economical machine.

The above considerations must interfere with the economy of the alternating system; still it must be remembered that the system is already successful in so many cases, that, in spite of these drawbacks, the field before it is immense. In Mr. Smith's paper it is especially gratifying to notice how the system has been improved, and is still being improved.

Mr. W. L. Church read a paper on 'Independent Engines for Incandescent Electric-Light Stations,' in which he pointed out, that, when the amount of energy required from an electric-lighting station varies within wide limits, it is better to have a number of small engines to drive the dynamos than one large engine. The reason evidently is, that while a large slow-speed engine is more economical than high-speed engines of smaller size, when both are working at a maximum efficiency, yet our single large engine would only be working at full load for a small part of the day, while the rest of the time it would be doing only a small part of its possible work, and its efficiency would be low. With a number of small engines, on the other hand, when our load decreases, we can shut off some of the engines and dynamos, keeping those that are left up to very nearly their maximum efficiency. Another point in favor of the small engines is, that they may be belted directly to the dynamos, thus avoiding the loss in the countershafting used with the large machine, — a loss that might amount to twenty per cent.

Among the other papers read was a very valuable one on electric motors by Dr. G. A. Liebig; while there were a number of others, all of considerable technical interest.

Pres. J. F. Morrison having declined a re-election, Mr. S. A. Duncan of Pittsburgh was unanimously elected president of the association.

Taken altogether, the meeting was the most important, both as regards attendance and the papers read, that the association has yet held.

WASHINGTON SCIENTIFIC NEWS.

Maj. J. W. Powell on Evolution in Civilized Man. — Ascertaining the Density of the Earth. — Submarine Oil-Springs in the Pacific.

Evolution in Civilized Man.

THE annual meeting of the Anthropological Society was held on Tuesday evening, March 6. Maj. J. W. Powell, the retiring president of the society, occupied the evening by reading a paper, the sixth of a series on the same subject, on the evolution of man.

In the opening portions of his address, Major Powell explained the doctrine of evolution as taught in the philosophy of Darwin and embodied in the phrases 'the survival of the fittest in the struggle for existence' and 'natural selection.' "Nature," he said, "gives more lives than she can support: there are more individuals requiring nourishment than there is food. Only those live that obtain sufficient nutriment, and only those live that find a habitat. Of the multitude of germs, some perish on the rocks, some languish in the darkness, some are drowned in the waters, and some are devoured by other living beings. A few live because they fall not upon the rocks, but are implanted in the soils; because they are not buried in the darkness, but are bathed in the sunlight; because they are not overwhelmed by deep waters, but are nourished by gentle rains; or because they are not devoured by the hungry, but dwell among the living. A few live because they are the favorites of surrounding circumstances. In the more stately phrase of the philosophy of evolution, they are 'adapted to the environment.' Evolution, or progress in life, is accomplished among animals or plants by killing the weaker, — the less favored, — and by saving the stronger and more favored. Many must be killed because there are too many, and so the best only are preserved. Those a little above the average are saved, and this is called 'natural selection.' But this general statement must be followed a little further, that its deeper significance may be grasped."

Major Powell then illustrated the operation of the law of evolution by showing the infinite variety of conditions presented by the earth as the home of living beings, some of the ways in which competition for life is carried on, and the manner in which plants become more perfect, and animals advanced. "The endeavor has been made," he said, "to show what the struggle for existence means, and the part which competition plays in biotic evolution. Competition among plants and animals is fierce, merciless, and deadly; out of competition fear and pain are born; out of competition come anger and hatred and ferocity. But it must not be forgotten that from this same competition there arise things more beautiful and lovely, — the wing of a butterfly, the plumage of the bird, and the fur of the beast; the hum of the honey-bee, the song of the nightingale, and the chatter of the squirrel. So good and evil dwell together."

Having thus characterized that competition which obtains among the plants and lower animals in the struggle for life, Major Powell continued, "It is proposed to characterize the competition which exists in the higher civilization between man and man, and to show in what respect it may be like, and in what respect it may be different from, biotic, which exists in the lower orders of creation; and for this purpose the savage and barbaric tribes of men will be neglected. Nor will the nations of early civilization be considered, but only mankind as he has obtained the highest civilization at the present time.

"In civilization, man does not compete with plants for existence. Thorns cannot drive him from fruits, husks cannot hide nutritious seeds from his eye, shells cannot defend sweet nuts from his grasp; but he speedily destroys from the face of the earth the plants which are not of the highest value for his purpose, and he plants those that are of value, and multiplies them in a marvellous manner, and by skilled culture he steadily improves their character, making the sweet sweeter, the rich richer, and the abundant more abundant.

"In the higher civilization, man does not compete with the beast for existence. There are no howling wolves or bears on our farms, there are no lions or tigers in civilized lands, and there are no serpents in our cities. All these dwell where civilization has not yet conquered its way. Civilized man has domesticated the animal: he hives the bee for its honey, he coops the bird for its eggs, he pastures the cow for her milk, and he stables the horse that his boy may ride on its back.

"In the highest civilization, the world is not crowded with human beings beyond their ability to procure sustentation; for, if some hunger, it is not because of the lack of the world's food, but because of the imperfect distribution of that food to all. Men are not crowded against plants, men are not crowded against beasts, and men are not crowded against one another. The land is yet broad enough for all. The valleys are not all filled, the hillsides are not all covered. The portion of the earth that is actually cultivated and utilized to supply the wants of man is very small: it compares with all the land as a garden to a plain, an orchard to a forest, a meadow to a prairie. Nature is prodigal of her gifts. The sweet air, as it sweeps from zone to zone, is more than enough to fan every cheek; the pure water that falls from the heavens and refreshes the earth, and is again carried to the heavens on chariots of light, is more than enough to refresh all mankind; the bounteous earth, spread out in great continents, is more than enough to furnish every man a home; and the illimitable sea has wealth for man that yet has not been touched. Thus it is that in human evolution over-population is not a factor, as it is in biotic evolution.

"In the highest civilization, man does not compete with man in the struggle for existence, and thus human competition is not biotic competition. In biotic evolution the wolf devours the fawn; but on the average he devours the weakest fawn, and the strongest fawn lives to beget a fleeter race of stags; and the evolution of stag-life is accomplished by such means. But when the highwayman waylays the traveller, and there is a struggle for existence which ends in a murder, no step in human evolution is accomplished thereby.

"Again: in the higher civilization, man does not compete with man in the direct struggle for the means of existence as does the brute. In the struggle for subsistence, one ox gores another to drive him from a blade of grass, one wolf rends another to drive him from a bone. Among the animals the struggle for the means of existence is direct, rapacious, and cruel; but in civilized society man shares with his fellow-man: the poor and the unfortunate are fed at the table of charity. A maimed beast is driven from the crib, but men and women will vie with one another to serve a maimed man; and one of the highest aspirations of civilized society is to dispense generous hospitality.

"Vestiges of brutal competition still exist in the highest civilization, but they are called crimes; and, to prevent this struggle for existence, penal codes are enacted, prisons are built, and gallowses are erected. Competition in the struggle for existence is the agency by which progress is secured in plant and animal life, but competition in the struggle for existence among men is *crime* most degrading. Brute struggles with brute for life, and in the æons of time this struggle has wrought that marvellous transformation which we call the evolution of animals; but man struggles with man for existence, and murder runs riot: no step in human progress is made.

"That struggle for existence between man and man which we have considered and called crime is a struggle of one individual with another. But there is an organized struggle of bodies of men with bodies of men, which is not characterized as murder, but is designated as warfare. Here, then, we have man struggling with man on a large scale, and here it is where some of our modern writers on evolution discover the natural law of selection, — 'the survival of the fittest in the struggle for existence.' The strongest army survives in the grand average of the wars of the world.

"When armies are organized in modern civilization, the very strongest and best are selected, and the soldiers of the world are gathered from their homes in the prime of manhood and in lusty health. If there is one deformed, if there is one maimed, if there is one weaker of intellect, he is left at home to continue the stock, while the strong and the courageous are selected to be destroyed. In organized warfare the processes of natural selection are reversed: the fittest to live are killed, the fittest to die are preserved; and in the grand average the weak, physically, mentally, and morally, are selected to become the propagators of the race."

After illustrating this point at some length, Major Powell said that it must now be shown what man has done with this law of evolution.

"A river has a precipice in its course, and where the water falls there is danger to man. The Indian, drifting in his canoe too near to the brink, is carried over the cataract, and his bones are left to bleach upon the rocks below. But at the same place the civilized man finds a power, and about the cataract he builds a city, and with the cataract he runs his mills and factories, and that which was a power of destruction to the savage is a beneficent agent in civilization.

"Two summers ago a young friend of mine, with two comrades, was sailing a boat on Yellowstone Lake. As he neared the shore, a little cloud spread overhead; then something happened that the members of the party knew not, for it came as an instant flash. Some time after the flash of unconsciousness, my friend, who was the leader of the party and the captain of the boat, opened his eyes once more to the light of day, and the sail of his little boat was all ablaze, and the mast was on fire, and a hole had been pierced in the bottom of his boat, and the waters of the lake were boiling up to fill it, and the gunwales of the boat were sinking down to the water's edge, and before him in the boat were two prostrate forms, — one paralyzed by the lightning-stroke, and the other dead from the lightning-stroke, — and he himself had his right arm seared by the terrible bolt; and the boat sank, but in shallow water; and the living struggled out to land, and the maimed buried the dead on the shores of the lake in the land of the beautiful. How terrible is the lightning-stroke! I had another friend whose daughter was stricken with dire disease, and the wife and mother started with the invalid daughter to go beyond the seas, hoping that the mild breezes of the Mediterranean might waft the balm of healing to the loved one while she dwelt on Italian shores; but as the loved ones sailed away, and were lost behind the curve of the world, a great fear came over the heart of my friend that his loved daughter would not live to reach the farther land. Day by day the fear grew; but one day a flash of lightning came from beyond the sea through the ocean depths, and brought him a message of their safety. So the genius of man has transformed the very lightning of destruction into a messenger of love and joy.

"It is in the same manner that the genius of man has transformed this brutal, this cruel law of evolution into a beneficent agency for his own improvement; and to explain this is our delightful task.

"From the dawn of human culture in savagery, to the mid-day of culture in civilization, human genius has been producing many inventions for many purposes, and the good have given place to the better, and the better have yielded to the best.

"A sheep gathers the grass with his teeth, the ox with his tongue, and the horse with his lips; and teeth, tongues, and lips are modified and developed as these animals struggle for existence. But the savage, just a little higher than the brute, walks through natural meadows, and, with a stick in one hand, beats the grain from

the stalks of grass into a basket held in the other; then, to separate the grain from the chaff, he tosses it on a tray, that the passing breeze may cleanse it; then the grain is roasted, and ground between stones, one lying on the ground, and another held in the hands, — two mealing-stones; and the flour is spread on a stone, and baked into a cake on the coals. So stick and basket and tray and mealing-stones and baking-stone are the implements and devices for gathering and preparing the cereal food of the savage. Then man invents a reaping-hook, then a grain-cradle, then a reaper; and in the process of invention from the sickle to the reaper, what a multitude of inventions are developed! Along this course how many tools, implements, and machines become obsolete and useless, that the one great reaper may remain! Here it is that we have 'the survival of the fittest in the struggle for existence;' and man, by his genius, transfers this struggle from himself to the work of his hands. The way from basket-reaping to power-reaping is long, but all the steps that way have been taken in the endeavor of mankind to secure greater happiness."

Major Powell also illustrated the evolution of the power-thresher from the flail, of the most improved winnowing-machine from the fanning-tray, of the steam or water power flouring-mill from the mealing-stones, etc.

"The sheep, the ox, and the horse make their struggle for existence with teeth, tongue, and lips; but mankind has passed beyond the stage where he must struggle for existence, into that condition where he endeavors to secure greater happiness. Tongue, teeth, and lips are no longer developed along the line of animal evolution; but human evolution is established by the development of human arts, and this struggle for existence is transferred to painless objects."

This truth was further illustrated by describing the evolution of the chronometer from the clepsydra and the hour-glass, and of the ocean steamship from the raft.

"Among bi-sexual animals, one of the agencies of evolution is sexual selection. Brutes fight with one another for mates, and in the grand aggregate the weaker are killed, and the stronger are preserved to perpetuate their kind; and various devices are gradually developed for attracting and winning mates, and the forms, colors, and habits of animals are modified thereby. But even in savagery this battle for sexual love is largely avoided, and, that peace may be preserved, marriage institutions are established. It seems at first that men in groups agree to marry women in groups. A group of men holding a group of women in common, defend one another's rights from violation from without, and live together in peace. On this plan there supervenes another system of institutions for marriage, where a group of men are destined to become husbands of a group of women in severalty, and the selections are not made by the parties themselves, but by the elders; that is, where marriage is by legal appointment within prescribed groups. Thus marriage institutions change from age to age, and from state of culture to state of culture, until the highest civilization is reached, where the man marries the woman of his choice on the sole condition that he is the man of her choice, and where the man must have but one wife, and the woman but one husband, and the twain are one in love, in purpose, and in law. But in the course of this evolution of marriage institutions, how many customs have obtained, how many agreements have been made, how many laws have been enacted! And along the entire course of the history of marriage institutions, customs and laws have disappeared, that new and better customs and laws might take their places; and the struggle for mates existing among the lower animals has been replaced by the endeavor to secure peace and happiness in human society. Thus man has transferred the struggle for existence from himself to his institutions. The marriage ceremony of the beast with his mate is a battle with a rival: the marriage of a man with his mate is a festival of kindreds and friends. And wherever any vestige of the beastly struggle remains in human society, there crime is committed, and the course of human evolution is checked. The way from communal marriage to monogamy and personal choice is very long, but every step in it has been taken by man in his endeavor to secure greater happiness."

The evolution of institutions was further shown by the establishment of authority, the history of which was traced from the elder-right through the right of the noble, by constant and long endeavor, into the right of the representative.

"Comparing animals with men, among the brutes rights and duties are distributed by hoofs and claws and horns and fangs, and by all brutal powers; but among men rights and duties are distributed by institutions.

"In this brief review of the growth of institutions, it is observed that forms of government are ever changing, that the constitution of the State is ever changing, and that the laws are ever changing. As these changes proceed, better institutions are selected by men; and thus is secured a 'survival of the fittest in the struggle for existence' among institutions. In civilization man does not struggle with man for existence; but by the invention of institutions he emancipates himself from the reign of terror inherent in brutal competition, and transfers the struggle from himself to the institutions of his creation.

"All of this statement may be summarized in this manner: man does not compete with plants and animals for existence, for he emancipates himself from that struggle by the invention of arts; and, again, man does not compete with his fellow-man for existence, for he emancipates himself from that brutal struggle by the invention of institutions. Animal evolution arises out of the struggle for existence; human evolution arises out of the endeavor to secure happiness: it is a conscious effort for improvement in condition.

"But arts and institutions alone have not secured the evolution of mankind, for they have been powerfully aided by two other classes of human invention, — namely, linguistics and opinions, — and the part which they have taken must be mentioned."

Major Powell then showed that the same struggle for existence, and the same survival of the fittest by human selection, which have been found among inventions, and again among institutions, may be discovered among languages and linguistic methods and devices. "By human endeavor, man has created speech, by which he may express his thoughts. And out of this endeavor, in all lands and in all time, the unorganized languages of savages have been developed into the languages of modern civilization; and all this progress, all this evolution, is by human endeavor; and in it natural selection, as that term is understood in biology, has played no part.

"Along the course of human progress opinions have been changing. The cruelty of nature in biotic evolution has been set forth. In this figure of speech, Nature is personified, and, if we still personify Nature, to the savage man Nature was ever a deceiver and a cheat.

"Nature tells the savage that the earth is flat, over which the sky is arched as a solid dome; then Nature tells the savage that the sun travels over the flat earth, and under the sky of ice, by day from east to west, and returns again in a cave by night from west to east; then Nature tells the savage that the rain comes from the melting of the ice of the sky. Many, strange, foolish, and false are the stories that Nature tells to the untutored savage. Nature is the Gulliver of Gullivers, the Munchausen of Munchausens. Nature teaches men to believe in wizards and in ghosts. Nature fills the human mind with foolish superstitions and horrible beliefs. The opinions of the natural man fill him with many fears, give him many pains, and cause him to commit many crimes. Out of all these savage superstitions, man has travelled a long way into the light of science. And how shall the opinions of modern civilization be characterized? And who can tell how the knowledge of the highest civilization transcends the knowledge of the lowest savagery? And so opinions have been changing, — old opinions have died, and new opinions have been born, — and philosophies have struggled for existence as man has endeavored to learn; and with man forever the struggle to know has been the endeavor to secure happiness, for truth is good, and wisdom is joy.

"Attention has already been called to the fact that among the lowest forms of life there exists a marvellous rate of reproduction. As life advances, and plants and animals are developed, the powers of reproduction are curtailed, until man in the highest civilization, and in the highest culture of that civilization, is reached, when the rate of reproduction is at a minimum. In this state of culture the transfer of the struggle for existence from man to the works of his creation is completed. With this transfer there occurs another of

wonderful nature. The marvellous powers of reproduction are transferred from the body of man to the soul of man, and he multiplies his intellectual creations at an amazing rate. Arts are multiplied to secure the joys of life, institutions are multiplied to secure justice, linguistics are multiplied to secure mental communication, and multiplied truths are discovered, so that the body of science is expanding towards the infinite and towards the infinitesimal.

"Among the lower animals the law of exercise is potent: the organ which is used is developed; disuse leads to weakness, decay, and ultimate loss. In human evolution the same method of progress by exercise is discovered to be one of the important factors.

"Through the inventions of mankind his mind has been developed. If we review the history of the human race, and fully comprehend what mental effort has been put forth to invent the arts of civilization and all the arts that have passed away by being superseded from age to age by better inventions, and fully grasp the mental efforts involved therein, we may comprehend that there is some good reason why the inventor of the electric light is superior to the inventor of the torch, why the inventor of the telegraph is superior to the inventor of the smoke-signal, why the inventor of the machine-shop is superior to the inventor of the flint-factory, why the inventor of the railroad is superior to the inventor of the dog-sled, why the inventor of the newspaper is superior to the inventor of a picture-writing on a bone. It has caused some exercise to bring about all the mental evolution which these differences implied."

This exercise of the human mind was further illustrated in the organization and re-organization of States, the enactment of laws to take the places of those that have been repealed, and in the establishment of courts. "To invent and apply human institutions, the mind of man has been forever at work, and out of this exercise has come a share of the evolution of the human intellect.

"Modern industries have been highly differentiated, or, the political economists would say, in modern industry there is great division of labor. By this division of labor men are made interdependent. No man lives for himself, but every man lives for others.

"When a man invents a new thresher, it is not that he may thresh his own grain, but that his neighbors may use it, that all the world may have it, and they, in return, may contribute to his happiness. If a man invents a new regulation or law, it is not that his own conduct may be regulated thereby, but that some injustice may be removed, or some justice be established, in the relations of the people of the State one to another. The farmer plants a field to raise wheat for his neighbors' bread, the gardener plants the vineyard to raise grapes for his neighbors' wine, the lawyer pleads his neighbors' cause, the physician gives nepenthe to his neighbors' pain, the poet writes for his neighbors' delight, the artist paints for his neighbors' gallery, and the philosopher expounds for his neighbors' instruction.

"All honest men are working for other men. If a man works exclusively for himself, he is a counterfeiter, or a forger, or a sneak-thief, or perchance a highwayman. All love of industry, all love of integrity, all love of kindred, all love of neighbor, all love of country, and all love of humanity, is expressed in labor for others. For this service thus performed a right to a reward is required, and he for whom the service is performed has imposed upon him the duty to render the reward, and the service is rendered in the hope of the reward. Everywhere in civilized society men are thus working for others. Every man, in all the years of his labor, toils for his fellow-man, and the practice is universal among all honest civilized men, and lasts from generation to generation; and universal practice is gradually becoming crystallized into universal habit. One man is trying to make better houses for his neighbors, another man is trying to make better shoes for his neighbors, another man is trying to make better laws for his neighbors, and another man is trying to make better books for his neighbors. Every man is thus forever dwelling upon the welfare of his neighbors, and making his best endeavor for their good; and thus the habit grows from generation to generation, until at last some men forget that there is reward for service, and labor for their fellow-men because they love their fellow-men.

"It has been seen that no man works for himself. The counterpart of this is that every man is dependent upon his fellow-man. That he may have good and abundant food, he desires the welfare of the farmer; that he may have good clothing, he desires the welfare of the manufacturer; that his rights may be maintained, he desires the welfare of the statesman, the jurist, and the administrator; that he may have the truth, he desires the welfare of the author; that he may enjoy poetry, he desires the welfare of the poet; and that he may enjoy art, he desires the welfare of the artist. It is thus that man is taught that he who loves the world loves himself, and he who hates the world hates himself. So it is that man toils for others and plans for their welfare, and others toil for him and plan for his welfare; so that every man's good is bound up with every other man's good, and every man's evil is an evil to every other man. And as man forever desires the good of his neighbor for his own sake, from generation to generation the desire for his neighbor's welfare for his own sake gradually becomes the desire for his neighbor's welfare for his neighbor's sake. Thus it is that selfishness is transformed into love, and justice and love are developed into the ethics of mankind. A part of the endeavor of mankind is governed by the principles of political economy, but the greater part is governed by the principles of philanthropy."

Major Powell then discussed competition among civilized men, which differs altogether from that competition which obtains among plants and animals. "It is a rivalry among men engaged in the same vocation to render a service to others that the reward may be received. Economic competition has or may have two factors, — emulation and antagonism. By emulation is meant the strife between men for greater excellence, — to perform better service for their fellow-men. By antagonism is meant strife in which man endeavors to injure his rival that he may himself succeed. Emulative competition results in human progress: antagonistic competition results in human retrogression."

The difference between these two kinds of competition was illustrated by the strife of artists to make the best pictures, by the organization of leagues or schools to instruct one another, and by such an appreciation of common interest in art as leads to great mutual help, and a comradeship that inspires to best endeavors. "Such generous emulation and all its products are in the line of human progress. But jealousies, unjust criticism, carping detraction, and vile slander lead to no progress among mankind. Every success in art creates among laymen an appreciation and love of art in every way beneficial to the artist himself. The natural man, in his ignorance, spurns all works of art. It is the cultured man that loves art; and the culture which brings appreciation and love of art arises from the ethical training which works of art give. In art, demand does not create supply, but supply creates demand. It is thus that the broad-minded artist rejoices in the success of his brother."

Further illustrations of emulative and antagonistic competition were drawn from the professional classes and from those engaged in agriculture. "The clientage of the latter is large and indefinite. The farmer is not striving to serve his neighbor Jones, but to serve the world. The farmers, too, are of great number; that is, there are many servants. For these reasons a farmer does not compete with his neighbor or with a number of specified or known persons, but his competition is with the whole body of farmers. For this reason, too, the spirit of antagonistic competition is never born: the competition of farmer with farmer is purely emulative."

These two kinds of competition were still further illustrated by the experience of the large body of people engaged in mining, manufacturing, and transporting industries. "Among them is both emulative and antagonistic. To avoid the evils of the latter, each class of employers is gradually organizing corporations or trusts; but by these, emulative competition is also avoided, for the managers of business enterprises no longer compete for business, but distribute business by convention. And in the same manner they repeal the law of competition in the labor market; they seek by convention to establish rates of wages. The employees in these same industries also compete with one another in two ways, — by striving to render their labor more efficient by skilled industry, and by offering to labor for smaller wages. The first method of competition is emulative, the second antagonistic. In all civilized society there is no competition so direful in its results, so degrading to mankind, as that which is produced among the

employees of these classes who compete for employment by cheapening labor, for it results in overwork which is brutalizing, and in want which is brutalizing; and the abolition of this form of competition is one of the great questions of the day. To avoid the evil, these people organize labor unions, but, while these destroy antagonistic competition, they also result in the destruction of emulative competition. The great problem in industrial society to-day is to preserve competition, and destroy antagonistic competition. The professional classes have already solved the problem for themselves, and they stand aloof and deplore the struggle; but they should learn this lesson from history: that, when wrongs arise in any class of society, those wrongs must ultimately be righted; and, so long as they remain, the conflict must remain; and when the solution comes not by methods of peace, it comes by war.

"Injustice is a strange monster. Let any body of people come to see that injustice is done them in some particular, though it may be one which affects their welfare but to a limited degree: they dwell upon it, and discuss it, and paint its hideous form one to another, until the spectre of that injustice covers the heavens, and gradually to that injustice the people will attribute all their evils. If a body of laborers receive unjust reward for their toil, they will dwell upon this evil so long, so often, and kindle their passions to such a height, that they will at last attribute to the failure of receiving a modicum of reward for their toil all the evils of their own improvidence, all the evils of their own intemperance, all the evils of their own lust; and if fire and flood come, the very evils of unavoidable misfortune will be attributed to the injustice of unrequited toil. Injustice is of such a nature that it must be destroyed by society, or it will destroy society. We dare not contemplate its existence with equanimity, for 'behold, what a great fire a little matter kindleth!'"

One of the most interesting illustrations of antagonistic competition given was that which exists in advertising. "The honest system of advertising should be but a small announcement of the offer of goods for the information of those who desire to purchase, in such a manner that those who desire to purchase, may, by seeking, find. But in advertising as it now exists, exaggeration is piled on exaggeration, and falsehood is added to falsehood. The world is filled with monstrous lies, and they are thrust upon attention by every possible means. The mails are filled with them. When a man opens his mail in the morning, the letter of his friend is buried among these advertising monstrosities. They are thrust under street-doors, and they are offered you as you walk the streets. When you read the morning and evening papers, they are spread before you with typographic display, they are placed among the items you desire to read, and they are given false headings, and they begin with decoy headings. They are posted upon walls, and on the fences, and on the sidewalks, and on bulletin boards, and the barns and housetops and the fences of all the land are covered with them, and they are nailed to the tree and painted on rocks. Thus it is that the whole civilized world is placarded with lies, and the moral atmosphere of the world wreaks with the foul breath of this monster of antagonistic competition."

In closing, Major Powell briefly reviewed the history of the land question in Great Britain, the conversion of the commons in England into the estates of nobles, until people learned that wanton extravagance of life is cured by elevating the poor to a higher condition, where they speedily learn the principles of prudential reproduction; and to-day, in that land, statesmen and scholars are devising the means by which those great estates may still be distributed among the poor. He also referred to the movements of wages among the laborers in Great Britain, their reduction to the lowest pittance on the plea in justification of the sanction of the immutable law of competition. Then there arose a philosophy which sought to ameliorate the condition of the poor people by charity. Still later a new philosophy arose, which taught that the wage-fund was limited, and was sufficient to supply only a limited number of workers; and so wages were reduced still lower, to be followed by strikes and riots, which threatened the beautiful isle with anarchy. "And now," said Major Powell, "another philosopher has arisen in the world, the great Herbert Spencer; and he has discovered another fundamental principle, a major premise, — that human progress is by 'the survival of the fittest in the struggle for existence.' That the fittest may survive, the unfit must die. Then let the poor fall into deeper degradation, then let the hungry starve, then let the unfortunate perish, then let the rich and the wise and the good and the strong live and flourish and propagate the race, then let the ignorant remain in his ignorance. He who does not seek for knowledge himself is not worthy to possess knowledge; and the very children of the ignorant should remain untaught, that the sins of the fathers may be visited upon the children. Let your government cease to regulate industries, and, instead of carrying the mails, let them erect prisons; let governments discharge their state-employed teachers, and enlist more policemen. Such is the philosophy of Spencer and his adherents. And they establish journals to advocate these principles, and edit papers to advocate these principles, and they have become the most active propagandists of the day; and the millions are shouting, 'Great is philosophy, and great are the prophets of philosophy.'

"Thus it is that fundamental principles, major propositions, are discovered to justify injustice, and yet forever man is endeavoring to establish justice. How this shall be done I know not; but I have such faith in my fellow-man, such towering faith in human endeavor, such boundless faith in the genius for invention among mankind, such illimitable faith in the love of justice that forever wells up in the human heart, that I swear by the eternal truth the problem shall be solved."

Density of the Earth.

The following is an abstract of a paper read by Mr. G. W. Hill at the last meeting of the Mathematical Section of the Philosophical Society: —

The relation which, according to Boyle's law, holds between the pressure and the density of the atmosphere or a gas under a uniform temperature, is so simple, that we are naturally curious to see the results of its application to the mass of the earth. The greater difficulty of the problem over that in which Laplace's law of density is employed may recommend it to us as a mathematical exercise.

The differential equation, which is satisfied by the density, is readily obtained by uniting the general equation of hydrostatics with the partial differential equation which the potential function at interior points satisfies. By certain substitutions the question is reduced to the integration of a differential equation of the first order and the subsequent quadrature. Unfortunately the first operation cannot be executed in finite terms, but the application of mechanical quadratures to the equation is quite easy. The differential equation defines a system of plane curves readily constructed by drawing their tangents at points suitably distributed. These curves fall into three groups, of which one takes up the space to the right of the vertical axis of co-ordinates, and is the only one applicable to the physical question under consideration.

A first illustration of the general theory is afforded by treating the density of the atmosphere considered as surrounding a spherical earth, in which one does not neglect, as usual, the attraction of the atmosphere on itself.

Passing to the problem afforded by the mass of the earth, the construction of a single one of the formerly mentioned group of planes, and the summing of a definite integral along its line, is seen to contain the solution of the whole matter.

A general table is then formed, from which we can obtain all the data needed for applying the general theory to any particular case.

Assuming the surface density as 2.7, and the mean density as 5.67, the density at the centre comes out 21.7, and at half the surface radius 9.4.

If the mean density is more than fifteen-fourths the surface density, there is no solution.

If the mean density is exactly three times that at the surface, the number of solutions is infinite.

For the case of the earth considered above, there is only one solution.

Submarine Oil-Springs.

The Hydrographic Office publishes upon the Pilot Chart for March some late information concerning submarine oil-springs on

the Pacific coast. The best known of these is off what is known as 'Coal-Oil Point,' about one and one-fourth miles west of Goleta, and ten miles west of Santa Barbara. Captain Van Helmes, of the American steamship 'Los Angeles,' says that when a vessel passes through this region the smell of the oil is so strong as frequently to cause nausea among passengers and crew, and in certain spots the oil can be distinctly seen bubbling up on the surface. Captain Wallace, of the American steamship 'City of Chester,' has also seen oil floating on the water to the north of Cape Mendocino, from three to five miles off shore, and thinks there is another spring there. Captain Plummer, of the American steamship 'Gipsy,' says the belt of oil above Santa Barbara can be seen on the darkest night when sailing through it. Captain Goodall, of the Pacific Steamship Company, says of the region off Coal-Oil Point, that on a calm day the water is covered for miles with oil, bubbles of which can be seen rising to the surface and spreading over it. Although it does not seem to smooth the water like animal oil, yet, on a windy day, one can see a smooth slick of oil on the surface. This spot is so well known by shipmasters, that the smell of the oil is used as a guide in foggy weather, the petroleum smell being so strong that a captain can never mistake his position when off that point. Captain Goodall says, also, that he has noticed a small flow of oil from the bottom of the sea off Cojo Point, near Point Conception, but there the amount of oil is very small. It cannot be seen bubbling from the bottom, but is often visible on the surface, the odor being very perceptible.

HEALTH MATTERS.

Scarlet-Fever.

THE following striking instance, illustrating the communicability of scarlet-fever, is sent us by Dr. George E. Goodfellow of Tombstone, Arizona, in answer to the letter of inquiry sent by *Science* some months ago: —

"I came to Prescott, Arizona, in 1876. At that time I was informed by physicians residing there for a number of years, that, to their knowledge, no case of scarlet-fever ever had been known either in the town or surrounding country. Prescott is a pleasant little mountain town of central Arizona, and at that time had a population of about eighteen hundred, and had been then, and is now, considered to be unusually free from disease. The altitude is about 5,800 feet. There was no sewerage system, nor was one needed. In this climate of the South-West, owing to the dryness of the atmosphere, excrementitious material desiccates so rapidly, and the residents are so unaccustomed to the vile odors of civilization, that they never have realized the necessity of supplying the pabulum of putrefaction, in the shape of water, to their sewage. There was not a foul-smelling outhouse in the town, save around the saloons and some restaurants; and there, be it noted, no one lived; neither was any one there, taken sick in the epidemic, to be recounted. I speak thus authoritatively of the condition of the village, for I was appointed health-officer, therefore knew the state of things. One more preliminary statement. Of the people living in Prescott and the encompassing neighborhood, almost all were considered as old residents; that is, they had emigrated to Arizona about 1862–64, mostly from the Pacific coast. There was comparatively little immigration into the Territory from 1868 to 1876–77. By reason of this, the children imported from California left that State before the advent there extensively of scarlet-fever and kindred diseases, and were now grown to manhood and womanhood without ever having had any of the contagious diseases of childhood. Many of these, particularly the girls, were married and had children; and it was among these children that the disease which proved so fatal started. Whatever the differences of opinion concerning the first cases, which made their appearance in May or June, 1877, the nature and malignancy of the fever were soon conceded by even the most sceptical. It was scarlet-fever in its most malignant form, and, if I recollect aright, it swept away between twenty and thirty children in that small burg before it ceased. But it was not confined to the children: the parents, particularly the young mothers, as described above, contracted the fever in all grades of severity, though usually in a mild form. There was a family, prominent in the place, with three children, aged from two to eight. I was the medical attendant. The eldest contracted the disease first, and in a few days the others had it. Two of them died about the seventh day, — the two younger ones. The other ultimately recovered. Owing to the popularity of the family, a large number of visitors, sympathizing friends, and curious neighbors, as is usual in small towns, had filled the place, spite of all protests from the physician, from the beginning of the trouble until the sad ending. Of the immediate friends, a large number were of the younger class heretofore described, that never had had scarlet-fever. Of these, the majority were taken down with some form of sickness related to the disease. Most of them had the fever outright, but some only had severe sore throats. The father, mother, consulting physician, and myself were all attacked. Whether I ever had had the fever, I do not know. The father, two young men, and myself, who had been closely in contact with the children from the beginning of their illness, lay at the point of death for some days; and, of all who were in the house, not one escaped without some manifestation of the disease. Thus effectually was the fever spread. It seems to me this is a striking illustration of the communicability of the disease. Of course, the objection may be raised, the sanitary conditions of the house were not good. But they were. The house was a new one, a year old, of wood, set up from the ground by short two-by-four scantling, so that the wind had an elegant chance to ventilate the building. There was no cesspool, or foul locus of any sort, in the neighborhood. It was, in fact, an ideally clean place. Some of those who had typical cases of the fever were twenty-four and twenty-five years of age.

"Now, here was an epidemic, which, so far as we knew at the beginning, had no antecedent case to initiate it. My subsequent investigations settled that point. It was ascertained that the previous year, at Fort Whipple, an army post near the edge of town, there had been some cases of what the post surgeon pronounced scarlet-fever. Thus died the case of the *de novo*ites. At any rate, the *onus probandi* of origin was put on the preceding year's cases. Where they came from, never was shown certainly; but as some families had recently joined the station, coming from infected points, it was a natural supposition to conclude that they brought it with them. This is the strongest concatenation of circumstances, derived from personal observation, I can give. I have not entered into details showing absence of other sources of contagion in the persons attacked. This must be assumed as having been established at the time."

VACCINATION STATISTICS. — The following extract from *The Sanitarian* would seem to indicate that a compulsory vaccination law has its advantages: "The success of the anti-vaccinationists is aptly shown by the results in Zurich, Switzerland, where for a number of years, until 1883, a compulsory vaccination law obtained, and small-pox was wholly prevented (not a single case occurred in 1882). This result was seized upon in the following year by the anti-vaccinationists, and used against the necessity for any such law, and it seems they had sufficient influence to cause its repeal. The death returns for that year (1883) showed that for every thousand deaths two were caused by small-pox; in 1884, there were three; in 1885, seventeen; and in the first quarter of 1886, eighty-five."

BLOOD-CHANGES. — The Paris correspondent of the *New York Medical Journal* says that the application of spectroscopy to the study of pathological alterations in the blood is receiving considerable attention in that city. So far, the considerable expense of the large instruments employed has to a great extent prevented any use being made in medicine of the principal characteristics of the coloring-matter of the blood, either in the normal or in the pathological state; but a late invention of Dr. Hénocque's places in the hands of the medical profession a handy, portable hæmato-spectroscope, that will almost go into a waistcoat pocket, and with which a spectral analysis, both qualitative and quantitative, of hæmoglobin and its derivatives (oxyhæmoglobin, methæmoglobin, etc.), can be made at the bedside. But it will be asked, What is the advantage of knowing this? Well, it has been proved to be of the utmost importance in the study of the variations of the activity of the reduction of oxyhæmoglobin in health and in disease. This Dr. Hénocque makes us *see* with his instrument applied to the thumb. A small elastic-band ligature is tied around the lower part of the thumb, and on the

hæmatoscope being applied to the nail, which is exposed to the usual daylight (as strong as possible, but that from a house-window is enough), the energy of the exchange going on between oxygen and the tissues can be seen. This new idea is of great practical importance in the study of the phenomena of nutrition, both in physiological and in pathological states; so that such physicians as Professor Germain Sée are now taking the matter up and applying it to the study of many pathological states, such as anæmia, etc. Dr. Hénocque is one of Professor Brown-Séquard's best men. He has given the results of some three hundred and seventy cases in which experiments were made.

BOOK-REVIEWS.

Proceedings of the American Society for Psychical Research. Vol. i. No. 3, 1887.

The appearance of Miss Fletcher's paper upon 'The Supernatural among the Omaha Tribe of Indians,' in the Proceedings of the Psychic Research Society, is of importance, because it shows that this society is in part ready to take the anthropological view of such notions, to find their interest in the recording of such popular beliefs as a contribution to the statistics of human thought with no more reference to their possible objective verification than is necessary to shed light upon their origin. Apart from this, Miss Fletcher's paper is extremely interesting as showing the naturalness with which the supernatural enters into the every-day life of unenlightened people. It is also noteworthy that the Omaha ghost lets himself be heard so much more than seen, while with us the reverse is the case. This fact is very suggestive, and several aids to an explanation present themselves. It is also worth mentioning how little the evolution of terror is associated with the 'ghost-noises' of the Omahas.

All those who have followed the eventful career of the 'Phantasms of the Living'—the depository of the work of the English Psychic Research Society—will read with interest the controversy between Mr. C. S. Peirce, the well-known mathematician and logician, and Mr. Edmund Gurney. The former makes a detailed enumeration of all such cases regarded by Mr. Gurney and his associates as a proof of spontaneous telepathy, and shows that a large proportion of these suffer from serious omissions and fallacies, mainly sinning against the principles of the logic of induction. This brings a lengthy reply from Mr. Gurney, and a still longer rejoinder from Mr. Peirce. The discussion turns upon details, and must be read in full. Two points may be briefly noticed. The first relates to the estimation of the probability of a certain thought occurring to our minds within a given period. This is always a delicate task; and, as so much of our mental activity goes on in the region of the unconscious, it seems safer to make a very liberal estimate in this regard; and, if we do this, a larger number of coincidences of such presentiments as the death of a friend (as prompted by an undefined feeling about his welfare) with the actual occurrence will be attributable to chance. It is through the neglect of this consideration that the evidential value of many of the best cases is decidedly weakened. Next, as Mr. Peirce well argues, if we admit that the cases as they stand defy explanation by ordinary reasoning, it is very easy to invent half a dozen hypotheses explaining the facts as well as does the telepathic theory, and in the minds of many people by no means as improbable as the latter.

The reports of the several committees are more than usually satisfactory. The report of the committee on thought-transferrence, apart from an injudicious closing paragraph, is a frank confession of negative results. The committee on experimental psychology, of which Dr. C. S. Minot is the chairman, give the results of their inquiries as to the prevalence of a feeling sufficiently strong to influence action with reference (1) to sitting down thirteen at table, (2) to beginning a voyage on Friday, (3) to seeing the new moon over your left shoulder. The results are, that both in men and in women the most prevalent superstition is (3); the least prevalent is (1); and that about one man in ten, and two women in ten, acknowledge a belief in these superstitions. Furthermore, the question, whether in choosing between two otherwise equally desirable houses you would be influenced by the reputation of the one as haunted, is answered in the affirmative by forty-four men and sixty-six women in one hundred; but it should be added that a large number place this choice on accessory grounds, and not on the hauntedness of the house. Whether these statistics will be taken as marking the prevalence of frankness or of real superstition, must be left for each to decide.

The reports on haunted houses and on mediumistic phenomena presents few points of interest. The opposite is true of Mr. Cory's admirable observations on hypnotic phenomena. Only a single observation of the many ingenious tests devised by Mr. Cory can here be given. The fact that some hypnotic subjects can associate a suggested hallucination with a blank card, is explained by supposing that some trifling irregularity on the card serves to their hypersensitive senses as the direct excitant of the hallucination. This Mr. Cory supports, and really proves. A pencil with one end slightly nicked is placed on end on a mantel, and the subject is given the suggestion that nothing is upon the mantel. Then eleven other precisely similar pencils are placed on the mantel, when the subject is asked to count them, and counts eleven. A strip of board is so held as to cover the nick on the one pencil, and under this condition the subject counts twelve, showing that the sight of the nick sets the mind so as not to count that pencil.

This valuable number of the Proceedings is concluded with two notes from the pen of Prof. William James. In the first, Professor James gives the results of experiments upon the 're-action time' in the hypnotic state; showing that it is at times longer, and at times shorter, than in the normal state, and that a more detailed analysis of the kind of hypnosis is necessary to explain these results. The other brings together a number of important facts concerning the 'consciousness of lost limbs.'

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Twenty copies of the number containing his communication will be furnished free to any correspondent on request.

The editor will be glad to publish any queries consonant with the character of the journal.

Diamonds in Meteorites.

On Sept. 4, 1886, a meteoric stone weighing about four pounds fell at Novy Urej, Krasnoslobodsk, in the Government of Penza, Siberia. In this MM. Latchinoff and Jorefeif found what they supposed to be diamonds of microscopic size. In an insoluble residue small corpuscles, showing traces of polarization, were harder than corundum, and having the density and other characteristics of the diamond, and were present to the amount of one per cent of the whole mass (see *Nature*, Dec. 1, 1887). Through the courtesy of his Excellency Julien V. Siemaschko of St. Petersburg, I have been able to procure a small piece of the meteorite. Mr. H. Hensoldt, section-cutter at the School of Mines, very kindly prepared sections of the same, which I found to contain metallic iron in small thin plates, magnetite in small opaque grains, a plagioclase felspar, and olivine in oval grains, but was unable to detect any of these bodies in the sections. Prof. H. Carvill Lewis, to whom I sent the material, informed me that he had extracted two small oval bodies, almost isotropic, and showing no more traces of polarization than occur in many diamonds. With some other fragments of the meteorite, and not with these, he made two good scratches on a polished sapphire. He did not mount the crystals, because they were again lost: so I could not examine them. He was, however, inclined to support the views of the describers.

I found, that, by grinding with a sapphire four particles of the meteorite, I distinctly made a number of minute but deep scratches on each polished face of four different sapphires with each piece of meteorite. These scratches are characteristic of but one mineral that we know, and that is the diamond; but they are evidently so minute, that they form a coating or an aggregate over the other minerals, and were too small to distinguish, but yet exist in quantity, and may also possibly be the amorphous form of the diamond known as carbon or carbonado (?) Small pieces of the meteorite were then boiled for some time in hydrochloric, sulphuric, and nitro-muriatic acids. This readily removed all of the iron and magnetite, leaving only the skeletons of olivine, on which were small black particles, one of which was elongated but rounded, suggesting two joined cubes(?) On crushing one of these olivine pieces

with black crystals attached, and grinding it with a polished sapphire, it readily scratched the same. If a larger quantity of material comes to hand, the writer will have polished a diamond with the powder of the meteorite, using a new wheel for the purpose. The writer has not seen the paper of MM. Latchinoff and Jorefeif, but there seems to be every reason to substantiate their conclusions.

These facts are of especial interest, since on Jan. 15, 1887, Prof. L. Fletcher, curator of the Mineralogical Department of the British Museum, read before the Mineralogical Society of England a paper on a meteorite which was found in the sub-district of Youndegin, Australia, in 1884, and in which he stated he had found a new form of graphite of cubic form, with the hardness of 2.5 and a specific gravity of 2.12. To this he gave the name of 'cliftonite,' calling attention, also, to the fact that Haidinger, in 1846, had found what he described as graphite pseudomorph after iron pyrites (*Poggendorf Annalen*, 1846, lxvii. p. 437), obtained by him from a nodule of graphite which had dropped out of the Arva meteorite. Gustav Rose (*Beschreibung und Entheilung der Meteoriten*, 1864, p. 40; *Poggendorf Annalen*, 1873) expressed an opinion that this mode of replacement of the cube edges on these crystals was suggestive of holo-symmetry rather than hemi-symmetry, and that this interpretation would exclude iron pyrites as a possible antecedent mineral.

The cliftonite was readily examined with a ¼-inch objective; and from its structure Professor Fletcher concluded, that, while it is different from native graphite, the sharpness, separateness, and completeness of the crystal, the brightness of the faces, the delicacy of the acicular projections, and especially of the obtuse, almost flat, square pyramids, or some of the faces, are quite sufficient to prove that the form has never had any other than its present tenants; in other words, that it is not a pseudomorph. When in cubes, the diamond has faces not very unlike those of the Youndegin crystals, and shows a similar bevelling of its edges by the rounded tetrahexedra. Again: Professor Fletcher says it might be argued, that, during a hurried crystallization of the carbon, circumstances initially favorable to the formation of the diamond had finally permitted the existence of carbon in a graphitic form only. He had also found distinct graphitic crystals, cube octahedrous in form, in the Cocke and Sevier County (Tenn.) meteorites.

When we consider that only a few meteorites have been examined for this mineral, we have reason to expect some interesting results in the future. GEORGE F. KUNZ.

New York, March 6.

A Pseudo-Meteorite.

THROUGH the kindness of Dr. DeWitt Webb of St. Augustine, Fla., I have been able to examine a portion of the so-called 'meteoric stone,' weighing over two hundred pounds, which was said to have been seen to fall in an old cultivated field near Middleburgh, Clay County, Fla., and which was exhibited at the Subtropical Exposition at Jacksonville, Fla. It is a concretionary limonite, and not of meteoric origin. GEORGE F. KUNZ.

New York, March 6.

Monocular vs. Binocular Vision.

AS a constant student of binocular phenomena, I have been much interested in Mr. Hyslop's letter in *Science* of Feb. 10. I have repeated the experiment illustrated by his Fig. 1, and confirmed his results. But I do not think they are to be explained by any supposed struggle between monocular and binocular vision, but in a far more obvious way, which, in fact, he himself suggests.

In binocular combination of such simple figures as circles, where the means of estimating distance is reduced to ocular convergence alone, the estimate is very imperfect and uncertain. Our knowledge so interferes with our visual judgment that we are apt to over-estimate the distance. In fact, many persons even find a difficulty in seeing the combined binocular image any nearer than the two monocular images. As long as attention is fixed on the combined circle, the homogeneous image of the needle will seem beyond, as it ought. This will be much more distinct if we range the point of sight back and forth, combining successively the needle-points and the circles. But when we transfer attention wholly to the double images of the needle, these latter will sometimes appear nearer than the circle; not, however, because the needle seems nearer than before, but because the circle drops to the plane of the paper, where it tends to go, anyhow.

The experiment illustrated by his second figure I cannot confirm. It is true that experiment with his figures as drawn in *Science* confirms his results, but this is only because the figures are badly drawn. The positions of the two small circles *b* and *c* are not symmetrical. When accurately drawn, I find, on combining, that the small circle and the large circle appear exactly on the same plane. My son, aged eighteen, and well practised in binocular experiments, confirms my results perfectly. Whether Mr. Hyslop's original figures were imperfect, or have been only badly copied, I know not; but the wonderful distinctness with which binocular combination will bring out and exaggerate the smallest differences in apparently similar figures, is well known.

JOSEPH LECONTE.

Berkeley, Cal., Feb. 22.

The Scientific Swindler Again.

THE following from the *Indianapolis Journal* of Feb. 24 may be of interest to those who have been the victims of the swindler so extensively advertised by your own and other journals: "The book-thief who has, under the names of W. R. Taggart, Professor Cameron, Professor Douglass, and various *aliases*, travelled over the country, representing himself as a scientific student, and borrowing valuable books, has been arrested in Cincinnati, where he gave the name of Otto Syrski. He was recognized yesterday by Professor Collett of this city, who was one of his victims. Professor Collet learned where his books had been sold, and will probably recover them." It is to be hoped that this will stop his operations, at least for a time. A. W. BUTLER.

Brookville, Ind., March 1.

A Critique of Psycho-Physic Methods.

DR. JOSEPH JASTROW, in the second number of the *Journal of Psychology*, discusses the principal psycho-physic methods now in use, and advocates a thorough reform of the science of psycho-physics. One of the principal conclusions at which he arrives is that no such thing as a differential threshold exists; that is to say, that there is no definite point at which the difference of two sensations ceases to be perceptible. Dr. Jastrow's arguments fail to convince us. He says, "The threshold is described as a point not exactly constant, but nearly so: above it all differences can be felt, below it all differences vanish into unconsciousness. No matter whether little or much below this point, they are utterly lost. It is idle to say, as Fechner at times does, that they differ in the amount of additional stimulation necessary to bring them up into consciousness, unless you mean that the series below the so-called threshold is an exact continuation of the series above it; and, if you do mean this, then the threshold loses all its distinguishing peculiarities, and ceases to exist." Further on, in discussing the theory of the right and wrong cases, he says, "It has been proved that the ratio of wrong answers increases as the difference between the stimuli decreases; but the 'threshold theory' claims that this last fails to hold after this difference has been diminished below a certain ratio."

In considering these objections, I may be allowed to treat two classes of sensations separately: first, the judgment that a difference exists is based on a sudden change in the character of the sensation either in space or time; second, the judgment refers to sensations separate in space or time or in both. As an example of the former, we may assume two adjoining fields of various colors or various intensities of light, or a sound suddenly increasing in intensity or height. The threshold theory says there is a certain difference between these adjoining sensations below which no difference will be perceived. Practically this is admitted by Jastrow. In trying to meet such an argument, he first says that there exists only an average threshold; i.e., the average smallest perceptible proportion of intensity or wave-length of the two sensations on which the observer is able to form a judgment. He continues, "Here you either (1) tacitly assume that not many observations are to be taken, or that (2) no matter how many observations were made, no mistake would ever occur."

The arguments of the advocates of the threshold theory are

somewhat different from what Jastrow would make us believe. In the first class of sensations there are two reasons for the existence of a threshold, — a physiological and a psychological. As a balance has a certain limit of accuracy beyond which it does not show differences of weight of two bodies, so our organs of sensation are not able to show differences between stimuli varying only to a very small extent. This is the physiological threshold. But, besides, the advocate of the threshold theory says it is necessary that the sensations should differ to a certain degree, else they cannot be distinguished. He does not say, however, as Jastrow assumes, that the magnitude of this least perceptible difference is the same at any moment. On the contrary, it depends on the state of mind of the person, and varies just as Jastrow's sensibility varies, every moment having its own threshold, the average of which is the average threshold of the observer.

The theory of the threshold may be summed up in the following remarks: —

Two sensations are given, the difference of which is to be judged upon. The judgment can have various characteristics. Either a certain phenomenon is observed which has no immediate connection with the sensations to be compared (for instance, the line dividing two fields of various colors is observed), or the sensations are separate in space and time. In this case the conception of the former is compared with the latter sensation. In the former case the physiological threshold is the main consideration, and for this reason it may be omitted in these brief remarks.

In the latter case let the sensations S_1 and S_2 be given, which are produced by the stimuli s_1 and s_2. Let S_1 be the first to be observed. In making the comparison, S_1 will not be correctly remembered; but the probability that another and similar sensation, S_x, which would correspond to the stimulus s_x, is produced, will be

$$W = \int_{S_x} f(s_x, s_1, C)\, ds,$$

the constant depending upon the conditions of the experiment.

Experiments show that W increases when the difference between s_1 and s_x decreases. Further experiments show that when the two stimuli s_1 and s_2 differ but slightly, in a great number of cases the observer will judge $S_1 = S_2$. According to the theory of probability, W_{S_2} is only very small as compared to all other possible reproductions. Therefore the only possible explanation of the fact that the judgment $S_1 = S_2$ is comparatively frequent, is, that not only in those instances when the conception S_2 is reproduced are both judged to be identical, but that sensations varying only slightly from S_2 cannot be distinguished from it; and the task of psychophysic methods is to find the limits of these variations. Mathematically the number of observations in which both sensations are considered the same is expressed by the following formula: —

$$W_1 = \int_{s_2 - \delta}^{s_2 + \delta_1} f(s, s_1, C)\, ds.$$

δ_1 and δ are the upper and lower thresholds respectively. This explanation agrees exactly with the observed fact, that slightly different stimuli cannot be distinguished; and Jastrow's objections are founded on a misconception of the mathematical basis of the theory. No advocate of the threshold theory assumes, as Jastrow supposes, that below the threshold the probability of a greater error is the same as that of a smaller error.

In another passage of his critique, Jastrow rejects the use of doubtful cases in the theory of right and wrong cases. It seems to me that his objections cannot be accepted. The fact is, that in a number of cases doubtful answers must be given. In his paper he says, and rightly, that the confidence is increasing with the difference of the sensations. Now, the answer 'doubtful' is nothing else than an expression of the degree of confidence; and, according to the above formula, the proper way to include these answers in the theory is to assume a second threshold which shows the limit of doubtful cases, and this has been successfully done.

It will easily be seen that variations of a sensation such as assumed by the theory outlined above always occur, and that they must prevail in all psycho-physic experiments except in the first class.

Dr. Jastrow's suggestion to measure the sensibility by psychophysic methods is a good one. It has been successfully applied for measuring various degrees of attention, and the writer fully agrees with Dr. Jastrow's opinion that this is the most promising field of psycho-physic research.

DR. FRANZ BOAS.

New York, March 1.

American and Foreign Microscopes.

MY attention having been called to the 'Complaint' in *Science* for Dec. 2, 1887, and the following articles on microscopes, the facts did not seem to me fully presented therein. I immediately addressed the following questions to more than twenty of the leading colleges of the country, the Department of Agriculture, Geological Survey, and Microscopical Society of Washington, D.C., and Messrs. Wolle and Smith, two of the oldest microscopists in the country. The results are herewith presented, with my own ideas on the subject.

The questions were, 1. How many microscopes of American make have you? [659.] 2. How many of foreign make? [434.] 3. How many without a joint? [309.] 4. Do your students work standing, or sitting? 5. Is the instrument used in an inclined position to any extent?

The figures in brackets give the sums total of the replies. Pennsylvania University reports 100 American, 3 foreign; Michigan, 120 American, 30 foreign. Of the foreign instruments, 108 belong to Harvard, and 135 to Bryn Mawr, Johns Hopkins, and Massachusetts Institute of Technology. About 40 jointed instruments are reported used in the upright position; more than two-thirds of the whole number are used inclined. To No. 4, the answer "Sitting," is almost universal; "Standing or sitting," a few. The following extracts from the replies are pertinent: —

"I prefer to work it upright, and teach my students so, but they will incline it whenever possible."

"When long at work, I prefer a vertical tube; but I find for young students the inclined position and the rack and pinion extremely desirable."

"Only by unfortunates. Of course, the joint is a convenience, but is not, in my opinion, essential." — HARVARD COLLEGE, in answer to No. 5.

"The instruments are used almost exclusively in the upright position, the tables being low enough to permit of such use with ease." — UNIVERSITY OF NEBRASKA.

"Mostly foreign instruments, generally inclined, prefer inclined; would use it inclined if I could" [of upright instruments]. — GEOLOGICAL SURVEY.

"The latest purchases are American, which are now preferred." — ALBANY.

"Personally, I believe the best instruments are made in this country." — UNIVERSITY OF MICHIGAN.

"In my laboratory (physiology and hygiene), we use forty. I bought the first in 1876, foreign because then cheaper. In four years they were all worthless. We then bought American: they have stood more rough usage, and had fewer repairs necessary, than any others. My work is especially trying on account of the frequency with which acids must be used."

"I believe the eye is more nearly in its normal and best position when the microscope is inclined." — PRINCETON.

"My constant companion at my table is Zentmayer's army microscope. Have used it twelve or more years, always inclined, or very rarely vertical." — F. WOLLE.

"Twenty-five years ago I got Powell and Lealand's stands. I seldom use their objectives. For long years I have preferred American objectives. I have recently seen letters from purchasers of Zeiss apochromatics, confessing that Spencer's most recent glasses fully hold their own, and at less prices." — H. L. SMITH.

"The facility to incline when needed is indispensable." — J. G. HUNT.

In 1862 I saw much of Dr. Hunt, then unsurpassed as a histologist. He used a Beck best, inclined, in continuous daily work. His experience assisted in the construction of the American Centennial instrument, which he has since used. This is an instance of an elaborate tool employed in actual, original, and long-continued work. After this came the Beck International, costing seventeen

hundred dollars, and with the most elaborate accessories ever offered to the public, — no doubt 'brazen elephantiasis,' but not an American instrument. The latest Zeiss instruments brought to this city have just the same nickle plating and lacquer as the American; and without lacquer any instrument would be soon worthless.

In 1860 I used a French upright, then successively a Nachet best, Zentmayer, Beck small best, Popular, and in my laboratory Bausch and Lomb Model and Harvard. In 1875 I brought over a lot of Zeiss's work. I use the inclined position always, except for watch-glasses, or such large vessels. Have used fluids contantly, on tissues, in the examination of fibres according to Vetillart, and numberless examinations of urine, as well as chemical work. The capillary attraction between cover and slide is sufficient, as a rule, to hold all that is required.

I do not see that the disclaimer in the last article affects the statements made in the 'Complaint.' Histological work is the investigation of the minute structure of plants and animals, and this is just what microscopes are made and used for in this country in biological laboratories and by practising physicians. The number of amateurs is very small, and, of instruments used for petrographical and chemical work exclusively, still smaller. In the Washington society, twenty-six members are physicians, nearly all in practice, seven are teachers and investigators, and seven are amateurs.

The American stand has been developed from, and has re-acted upon, the English stand, — a different and radically better type than the German. There are probably as many microscopes made and used by English-speaking people as by all the rest of the world. A Beck was exhibited at one of the late meetings of the Washington Society numbered over 15,000. This means over that number of jointed instruments in use, of one English maker, of which about one-third are in this country. The latest Zeiss here is 11,468 (August), and all but his lowest styles have a joint.

Most English microscopes have a joint, — a feature of the Germans first despised, then condemned, and finally adopted. The jointed stand does all that the upright does, and much that the upright cannot do. The cost of the joint is about two dollars. The Zeiss stand VII, *a* and *b*, is said by Zeiss to be "especially suitable for laboratory use." It has no joint. Its stage is 67 by 72 mm., and 86 mm. high. The price, with two objectives and two eye-pieces, is $34; with another objective, $41. The Zentmayer Histological (American) was put on the market in 1876. It has a joint. Its stage is 65 by 95 mm., and 76 mm. high. With one eye-piece and two objectives and case, it costs $38 and $46. The Bausch and Lomb Harvard has a stage 85 by 90 mm., and 82 mm. high. With two objectives and two eye-pieces, the price is $43. It is well known that the discounts here are larger than on foreign catalogue prices; and in quantity these American instruments, with lower and broader stages than the foreign instruments of equal grade, can be purchased cheaper. No one is obliged to buy a slide-carrier unless wanted. It is priced separate. The glass slip stage was an American invention, was adopted by the French and English makers, and is stated by Dr. Carpenter, in his last edition, "to be the most perfect yet devised." The Iris diaphragm is not generally applied by American makers to college microscopes.

The prices of German low-power objectives are less than American, but high powers are dearer. A Zeiss $\frac{1}{12}$ costs $90, a $\frac{1}{20}$ $112 to $140, to which must be added the cost of special eye-pieces. A Spencer first-class dry $\frac{1}{15}$ costs $60, a $\frac{1}{15}$ homo immersion $80, both high angle; a professional $\frac{1}{8}$ of 175 B.A., $40. If these prices are averaged with the low powers, the American lenses are cheapest, without any regard to duty. We want three classes of microscopes, — the college, the professional, and the complete. The first may have less finish and no substage fittings, the second with substage fittings and better finish, the third with graduated circles, etc. All require a spreading tripod base, a joint, a Jackson arm sitting square on the trunnions, a firm clamp to the latter, and the arm cast solid from the axis of the swinging tail-piece to the barrel.

Our catalogues should give for each instrument the height and size of stage, and the length of barrel.

There has already been much discussion on the uniform construction of microscopes at the meetings of the American Association of Microscopists. A resolution in this direction offered by the writer last summer was ruled out on the ground that the subject was exhausted for the present. An important contribution on tube-length read at Pittsburgh by Professor Gage has already appeared in *Queen's Bulletin*, and will be published in the forthcoming Proceedings of said society.

Colleges pay no duty on their instruments: hence their selection is not affected by the tariff. As to the principle, I am an American citizen and a teacher, and, other things being equal, I prefer to buy my microscopes of my neighbor, who will send his children to my school, and who, if he grows rich making microscopes, may endow my college, rather than to send afar, to one who is not likely to be interested in my success or that of my country. I know professors of political economy do not teach this view; but most business-men act according to it, though the principle may be unwisely applied. Under it as the rule of our national polity, we have made the best and cheapest watches, telescopes, and apparatus for the investigation of radiant heat; and, if the users of microscopes will only co-operate fairly with the makers thereof, we shall soon have the best and cheapest microscopes the world has yet seen. Many who condemn protection, ask for international copyright; and one of their arguments is, that, by raising the price of foreign literature, it will make a better market for domestic productions. So it will, and tend to shut out some excellent foreign work, and is so far just as 'absurd and senseless' as the duty on microscopes.

For details on the above matters, see HARTING, *Das Mikroskop*, vol. iii. p. 262; MAYALL'S 'Cantor Lectures;' and Hon. J. D. COX, 'Microscopic Work,' *American Journal of Microscopy* for 1879, p. 131.

W. H. SEAMAN, M.D.

Howard University, Washington, D.C., Feb. 25.

Indian Wrist-Guards.

IN a review of Professor Morse's 'Methods of Arrow-Release' in *Science* last year (ix. p. 122), I ventured to suggest "whether it is not possible that the so-called 'pierced tablets,' which are described and figured by Professor Rau (*Archeological Collection of the Smithsonian Institution*, p. 23) and other writers, and which have given rise to so much discussion among American antiquaries, may not have been guards worn to protect the wrist against the recoil of the bow-string." Since writing this, I have happened upon an article by R. S. Robertson, in *The American Antiquarian* (i. p. 100), in which he advances the same opinion. He says, "A short time since, when exhibiting one to an old gentleman, who was a clerk for a fur-trader, while the Miamis still occupied the region around Fort Wayne, he assured me he had often seen them in use, and that they were worn on the left wrist to ward off the blow of the bow-string in hunting." I have lately noticed statements in early descriptions of the customs of the Indians, which seem to me to lend some countenance to this view. Capt. John Smith, in his 'Map of Virginia,' p. 23 (Arber's reprint, p. 68), telling how the Indians make their bows and arrows, says, "His arrow-head he quickly maketh with a little bone, which he ever weareth at his bracer, of any splint of stone or glass in the form of a heart." Strachey, in his 'Historie of Travaile into Virginia' (Hakluyt Society edition, p. 106), employing precisely the same language, adds, "and which bracer is commonly of some beast's skin; either of the wolf, badger, or black fox." In the 'General History of Virginia,' which comprises a reprint, with additions, of 'The Map of Virginia,' Third Book, p. 15 (Arber's reprint, p. 397), in an account of the capture of Smith, we are informed that the Indians had "every one his quiver of arrows, and at his back a club; on his arm a fox or an otter's skin, or some such matter, for his vambrace."

Winslow, in 'Good Newes from New England' (Young's edition, p. 365), says, "The men wear also, when they go abroad in cold weather, an otter or fox skin on their right arm, but only their bracer on the left."

As 'bracer,' or 'vambrace,' was the common term employed by old English writers to designate armor worn upon the fore-arm, we are authorized to infer from these statements that the Indians were accustomed to make use of the skin of some animal for a similar purpose. It would seem to be a very easy transition from a piece of leather to a thin, flat tablet of stone, pierced near the centre usually with two holes, which could readily be adjusted to the wrist as a guard.

In ancient Egyptian tomb-paintings (WILKINSON'S *Ancient Egyptians*, i. p. 351), archers are depicted wearing such wrist-guards; and in the European museums it is quite common to find small, oblong, thin plates of bone or ivory, pierced with holes, which are universally regarded there as having been employed for such a purpose. HENRY W. HAYNES.

Boston, Feb. 29.

Notes on the Geology of the Cascade Range.

IN *Science* of Feb. 10, Mr. Herbert Lang discussed evidence bearing on the history of the Cascade Range in Oregon. It may be of interest in connection with Mr. Lang's conclusions to state some facts observed by the parties of the Northern Transcontinental Survey in explorations conducted in Washington Territory from 1881 to 1884.

Coal was the prime object of these surveys, and work was most thorough where it was found in greatest abundance; but the prospecting parties covered the greater part of the Cascade Range north of Mount Rainier, and the facts which follow are of my own observation unless otherwise stated.

It was found that the formations of the Cascade Range in Washington Territory are, 1. Glacial drift; 2. Tertiary eruptives; 3. Unaltered sandstones and shales containing numerous carbonaceous beds, thickness 13,000′± (Laramie?); 4. Local conglomerates (cretaceous?); 5. Altered sediments; 6. Granite.

The granite base of this column was observed beneath the eruptives of Mount Rainier by Mr. S. F. Emmons in September, 1870; it crops out extensively on Upper Cedar River, a stream which enters Puget Sound at Seattle; it forms the heights of the Peshastan Range, north of Ellensburg; granite cliffs of the western side of the Columbia Cañon oppose basaltic walls of the eastern bank from the mouth of the Methow River to the Wenatchie, and granite forms the mass of the Cascade Range north of the Snoqualmie Pass. In remarks recently made before the Philosophical Society of Washington, Dr. George M. Dawson described the continuation of this granite backbone northward for nine hundred miles, and he dwelt upon the absence of volcanic rocks north of the 49th parallel.

The altered sediments which rest upon the granite have yielded no fossils by which their age might be guessed, but they resemble rocks assigned to the paleozoic age by the Canadian survey, and may be of the same horizons. The beds consist of crystalline schists, limestone, and quartzite. They occur throughout the Cascade Range, from latitude 46° northward, and in the Olympic Mountains. Gold has been found in the crest east of Mount Rainier, in gravels derived from the Olympic mass, and on Ruby Creek, a tributary of the Skagit River. Magnetic iron ore occurs in the formation near Snoqualmie Pass, and hard blue specular ore occurs in association with jasper on the Skagit River. This ore and its associations very closely resemble the specular ores of Lake Superior, but they probably belong to a very different period of geologic history. Limestone and schist traversed by quartz veins form an extensive area south and west of Mount Baker, bounded on the north by coal-bearing sandstones.

The altered sediments underlie later unaltered deposits, probably unconformably; but no contact has been sufficiently well observed to determine a definite relation. A conglomerate containing agatized casts of baculites (?) was observed by an intelligent prospector on Skookum-chuck Creek, south-east of New Tacoma; another conglomerate was seen by myself in the Peshastan Range (it consisted of large granite and quartz pebbles, resting on granite, and was several hundred feet thick); and at the coal-mine on the Skagit River, sandstone dipping 40° south-west rests upon iron ore bearing schists dipping 35° south.

These three instances are the only ones known to me in which the apparent base of the recent sedimentary beds has been seen. They mark the beginning of a profound subsidence during which accumulations of sand and clay appear to have kept pace with the sinking surface. In the Wilkeson Coal-Field the thickness of these beds probably reaches 13,000± feet, with 127 coal-beds, ranging from one to forty feet in thickness. This deposit is shown by its fossils to be of fresh or brackish water origin. Unfortunately no large collections were made, and the fossils do not definitely determine the age of the coal-measures; but Prof. J. S. Newberry and Dr. C. A. White agree in considering them the probable equivalent of the Laramie.

These recent sediments occur throughout the Puget Sound basin, they rim the Olympic mass, they have been found in the high crest of the Cascades near Cowlitz Pass, and north of Natchez Pass, and they were deposited to a thickness of about 1,000 feet in the region now drained by the Upper Yakima and Wenatchie Rivers. The great thickness and wide distribution of this formation are unusual features of a fresh-water deposit, and it is difficult to conceive the conditions which maintained fresh water over the area of such a subsidence. But the problem is somewhat simplified when it is recognized that the region was an archipelago like that so recently studied in southern Oregon by Captain Dutton and Mr. Diller. The Olympic peninsula was then an island, and the continuity of the coal-measure series may well be interrupted by similar spaces not yet traced out.

This formation was checked by compression, which resulted in folds of an Appalachian type having a nearly north and south trend. The closeness of flexure varies in different areas, and the chemical concentration of the coal is proportionate to the mechanical disturbance. The extreme of uniform alteration over an area of fifty square miles was reached in the Wilkeson coking coal; but local alteration, due to later volcanic influences, frequently went much further.

This compression closed the history of sedimentary deposits in this region. It may be assumed that it took place at the same period as the elevation of the northern portion of the Cascade Range, assigned by Dr. Dawson to post-cretaceous time; but we may not yet date the uplift more definitely.

A period of erosion intervened between the uplift and the outpouring of eruptives. Mounts Hood, St. Helens, Adams, and Rainier are the conspicuous peaks of the locus of maximum volcanic activity across which the Columbia has cut its cañon. Mount Baker is the northern outlier of the line of volcanoes which begins with Shasta and Lassens Peak.

Mr. Lang's hypotheses are in part confirmed by the facts stated; but like forces have produced unlike results in California and in Washington Territory. South of latitude 42° 30′ the Cascade's volcanic mass is supported on a slightly disturbed sedimentary base: north of latitude 46° 30′ the range of closely flexed sediments is dotted with volcanic cones. The difference is one of degree, not of kind; but the difference is great.

Many of the facts condensed in this note are stated, with more detailed descriptions of the coal-measures, in a report on the coals of Washington Territory, in Vol. XV., 'Tenth Census Reports.'

BAILEY WILLIS.

Washington, D.C., March 1.

Answers.

21. GLOBULAR LIGHTNING. — The late Prof. John Fries Frazer has frequently mentioned to me having seen in his youth a ball of fire descend and strike a tree in a field in front of him. Of course, this phenomenon happened during a thunder-storm. The distance from the object struck was about fifty yards or less. P. F.

Philadelphia, Penn., March 2.

22. WASP-STINGS. — The discussion going on in your columns at the present time in regard to wasp-stings recalls a curious discovery of my boyhood. I was a very ticklish youngster, and my comrades sometimes used that weakness for their own amusement. One boy used to show me how little effect tickling had upon him; but one hot summer day, as he was lying reading, I tickled him on the ribs, and he almost went into convulsions. I found that he was far more sensitive than any boy in the company, and he revealed his secret to me under condition of my never telling any one else. By holding his breath he became pachydermatous, and would let anybody tickle him as much as they pleased; but of course they always gave it up at once when they saw his stolid look. I tried the plan, and it worked admirably; and it is my only protection, even unto this day, for my cuticle is as sensitive as ever. The deduction is simple: a man holds his breath, — and a wasp, — and the stinger is 'bluffed.' *Verb. sap.* R. MCMILLAN.

Liverpool, Eng., Feb. 21.